

**Title** Combined effects of endo- and exogenous trehalose on stress tolerance and biocontrol efficacy of two antagonistic yeasts

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### Abstract

Effects of endo- and exogenous trehalose on viability of two antagonistic yeasts, *Cryptococcus laurentii* (Kuffer.) Skinner and *Rhodotorula glutinis* (Fresen.) Harrison, were investigated after being treated with rapid-freezing, slow-freezing and freeze-drying, respectively. The accumulation of intracellular trehalose in the two yeasts was induced by culturing the yeast cells in trehalose-containing medium, which significantly enhanced viabilities of both yeasts in the slow-freezing test. Trehalose, as an exogenous protectant, at the concentration of 5% or 10% could markedly increase survivals of the two yeasts when subjected to freeze-drying. When combined with exogenous trehalose as a protective substance, the yeasts containing high intracellular trehalose level showed higher viabilities as compared to those containing low levels under both freezing and freeze-drying stresses. The highest survival of *C. laurentii* and *R. glutinis* were 90% and 97% after freeze-drying, respectively, compared to 63% and 28% for the yeasts with lower intracellular trehalose levels. These results may be due to the fact that a combined effect occurred between endo- and exogenous trehalose of yeast cells. The combined effect on *C. laurentii* and *R. glutinis* also resulted in the highest level of biocontrol efficacy against blue mold in apple fruit caused by *Penicillium expansum* Link, and reduced the disease indexes to 45 and 56, respectively, compared to 94 and 81 in the untreated control. Meanwhile, the combination of endo- and exogenous trehalose significantly increased population of both yeasts in apple wounds, especially at the first 48 h after inoculation, which might explain the reason of the improvement in biocontrol effects of the two yeasts.